{In Archive} EARTHQUAKES: 'Remarkable' spate of man-made quakes linked to drilling, USGS team says

Ruben Casso to: Rob Lawrence, Michael Overbay 04/02/2012 07:58 AM

From: Ruben Casso/R6/USEPA/US
To: Rob Lawrence/R6/USEPA/US@EPA, Michael Overbay/R6/USEPA/US@EPA,
Archive: This message is being viewed in an archive.

EARTHQUAKES:
'Remarkable' spate of man-made quakes linked to drilling, USGS team says

Mike Soraghan, E&E reporter

Published: Thursday, March 29, 2012

A rash of earthquakes in the middle of the country appears to be related to oil and gas drilling, according to a group of researchers at the U.S. Geological Survey.

"A remarkable increase in the rate of [magnitude-3.0] and greater earthquakes is currently in progress," the scientists state in the abstract for their study. "A naturally-occurring rate change of this magnitude is unprecedented outside of volcanic settings or in the absence of a main shock."

The surge in temblors is "almost certainly man-made," they found, and all of the potential causes they explore in the paper relate to drilling, or more specifically, deep underground injection of drilling waste.

Casting the quakes as a trend could make it more difficult for oil and gas companies and state regulators to discount the earthquakes related to drilling as rare, isolated events. That, in turn, could provide new ammunition to critics who want stronger regulations, or even a ban on drilling.

The group of scientists, led by geophysicist William Ellsworth, is to present the paper next month at the annual meeting of the Seismological Society of America in San Diego. The abstract for their study has already been posted.

The study found that the frequency of earthquakes started rising in 2001 across a broad swath of the country between Alabama and Montana. In 2009, there were 50 earthquakes greater than magnitude-3.0, the abstract states, then 87 quakes in 2010. The 134 earthquakes in the zone last year is a sixfold increase over 20th century levels.

The surge in the last few years corresponds to a nationwide surge in shale drilling, which requires disposal of millions of gallons of wastewater for each well. According to the federal

Energy Information Administration, shale gas production grew, on average, nearly 50 percent a year from 2006 to 2010.

"This is very peculiar, what's going on," Ellsworth said in an interview with *EnergyWire* .

But there are disagreements about whether some of the events were triggered by activity related to drilling. And the abstract states, "It remains to be determined how they are related to either changes in extraction methodologies or the rate of oil and gas production."

The abstract states that a "modest" increase in quake activity near the Colorado-New Mexico border starting about 10 years ago was "due to" increased seismicity in a nearby coalbed methane field in the Raton Basin.

That contradicts a USGS report that said "we do not have any firm evidence of a direct relationship between the fluid disposal and the earthquake swarm." But Ellsworth said that conclusion is dated.

"The 2002 report was very cautious," he said. "Our report is based on another 10 years of data."

More recently, the study abstract says, another spate of tremors that began in 2009 "appears to involve a combination of source regions of oil and gas production." That combination includes a "swarm" of earthquakes in north-central Arkansas tied to underground injection of wastewater from hydraulic fracturing (*Greenwire* , June 22, 2011), along with other tremors in central and southern Oklahoma.

In Oklahoma, the rate of earthquakes greater than magnitude 3.0 "abruptly increased" from an average of 1.2 quakes a year for the previous half-century to more than 25 in 2009. But a study by the Oklahoma Geological Survey released earlier in 2011 found that most of the state's seismic activity did not appear to be tied to injection wells, although it said more investigation was needed.

In their study, the USGS scientists did not include a magnitude-4.0 earthquake in January in Youngstown, Ohio, that scientists have linked to underground injection of fracturing wastewater, or a magnitude-5.6 earthquake near Oklahoma City in November.

But another paper to be presented at the San Diego conference by University of Memphis seismologist Stephen Horton concludes that the November quake was "possibly triggered" by nearby waste injection wells.

There are 181 injection wells in the Oklahoma county where the November earthquake happened. But Ellsworth said researchers are also looking at "enhanced oil recovery" wells where oil and water are withdrawn.

"We don't know exactly what's going on, whether it's related to injection or withdrawal," he said. "We don't understand why it went up so quickly in Oklahoma, where recovery has been used for years."

The USGS paper is to be presented by Ellsworth, a former president of the Seismological Society, who is at the Geological Survey's Earthquake Science Center in Menlo Park, Calif.

The paper does not link any of the earthquakes to hydraulic fracturing, or "fracking," itself, but to injection wells that accept wastewater from "fracked" production wells.

Induced seismicity

Geologists have known for decades that deep injection of industrial waste can lubricate faults and unleash earthquakes. One of the most famous instances of man-made earthquakes, or "induced seismicity," occurred in the late 1960s at the Rocky Mountain Arsenal near Denver, where the Army manufactured chemical weapons.

Man-made earthquakes are rare. And quakes caused by underground injection have not caused injuries. Still, there are more earthquakes linked to injection of oil and gas waste than there are documented cases of drinking-water contamination linked to hydraulic fracturing.

And in the last year, earthquakes in Arkansas and Ohio near heavy drilling areas have set people on edge, forced the shutdown of wells and inspired new restrictions on injection wells (*Greenwire* , Jan. 5). No injuries were reported from those quakes, but they have caused some to question drilling practices and strengthened the opposition of others.

Earthquakes unleashed by drilling wastewater fall into a gap in federal environmental laws. Oil and gas producers are exempt from provisions of the hazardous waste statutes designed to prevent industrial waste injection wells from triggering earthquakes (*EnergyWire* , March 12). States can adopt stricter rules. Ohio is adding additional seismic testing in the wake of its tremors, but other states have not followed suit.

U.S. EPA has a team developing a series of recommendations to suggest to state regulators on earthquakes. The team started work last June and says it hopes the recommendations will help in "managing or minimizing" earthquakes triggered by oil and gas waste injection wells (*EnergyWire* , March 15).

In addition, the National Academy of Sciences is studying how several forms of energy production trigger earthquakes. According to the NAS website, the group's report, "Induced Seismicity Potential in Energy Technologies," is due out this spring.